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INOCULATION OF *PISOLITHUS TINCTORIUS* FOR ECTOMYCORRHIZAL DEVELOPMENT ON PINE SEEDLINGS

LUCKY PEAK NURSERY, IDAHO

By

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INTRODUCTION

Ectomycorrhizae, unique plant structures formed when certain fungi form a symbiotic association with plant feeder roots, are a key element in the health and growth of many conifers. Mycorrhizae significantly increase the absorbing surface area of the feeder roots due to the mycelial extensions of the fungus into the surrounding soil. Such surface expansion not only increases the plant's availability of nutrients, but the increased moisture absorption reduces the probability of plant moisture stress (Anderson and Cordell 1979).

The common practice of repetitive seedbed fumigation with soil biocides eradicates mycorrhizal fungi and other beneficial organisms from the root zone (Iyer et al. 1969). Native mycorrhizal fungi may recolonize the fumigated seedbeds via wind-disseminated reproductive spores released from sporophores (fruiting structures) produced in either neighboring productive seedbeds or nearby forested land. However, reliance upon natural recolonization alone may be risky. Newly-fumigated seedbeds have reportedly shown deficiencies of ectomycorrhizal fungi (Marx 1975). The lack of natural recolonization may have been due to weather conditions unfavorable for sporophore production, residue buildup from repetitive use of soil biocides, or remoteness of the nursery from forested sites harboring specific mycorrhizal sporophores. Artificially infesting soils with a cultured-mycorrhizae inoculum may prove feasible in nurseries reporting such deficiencies.

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Research and nursery field evaluations have demonstrated that Pisolithus tinctorius (Pers.) Coker and Couch, a mycorrhizal fungus native to the southeastern United States, can be successfully inoculated into fumigated nursery seedbeds (Marx et al. 1976, Marx and Artman 1978). Pisolithus tinctorius has a wide host and geographic range and can survive and grow on a wide variety of planting sites (Cordell and Marx 1977). It seems to be particularly beneficial to seedlings planted on poor sites.

A national pilot study to evaluate P. tinctorius mycorrhizal inoculum on various conifers in nurseries in 28 states was initiated in 1978. The two-year study was a cooperative effort by the Institute for Mycorrhizal Research and Development (Southeast Forest Experiment Station), Southeastern Area, State and Private Forestry, and Abbott Laboratories, a major pharmaceutical company in Illinois. USDA Forest Service's Lucky Peak Nursery, near Boise, Idaho, was not included in the study.

Personnel from the Lucky Peak Nursery and from the Regional Office Timber Staff repeatedly requested information and assistance regarding nursery mycorrhizal inoculations. Consequently, Region 4 Forest Pest Management (FPM) specialists initiated what would be the first of two mycorrhizal studies at the nursery in April 1979 similar in design to the on-going national study. The major exception to the procedures designed for the 1978 evaluations (Marx and Cordell 1977) was the sole use of the Abbott Laboratories P. tinctorius inoculum, omitting the comparison with the inoculum produced by the Mycorrhizal Institute in Athens, Georgia. Inoculum was produced and supplied by Don Kenney, Abbott Laboratories Section Head for Microbial Products Research.

Our first study was terminated in the fall of 1979 after first-year evaluations found little evidence of colonization by P. tinctorius. A "bad batch of inoculum" theory was credited for colonization failures.

With reforestation and nursery personnel still showing an interest in the opportunity to improve seedling survival and growth rates, FPM personnel, with the cooperation of Abbott Laboratories, initiated a second identical study at Lucky Peak in April 1981. This report documents the results of the second evaluation.

METHODS

Basically, we followed the methods established in the national study plan. Three application rates of P. tinctorius inoculum were incorporated into 4' x 4' sections (Figure 1) of previously fumigated seedbeds prior to sowing of lodgepole and ponderosa pine seed. Treatments were replicated five times for each species. Control plots were also installed.

Evaluations of mycorrhizal establishment were to be based on examinations of 1-0 and 2-0 seedlings lifted by hand in the fall of the 1-0 year and the spring following the 2-0 year, respectively. Evaluations were made by Abbott Laboratories, suppliers of the P. tinctorius inoculum.

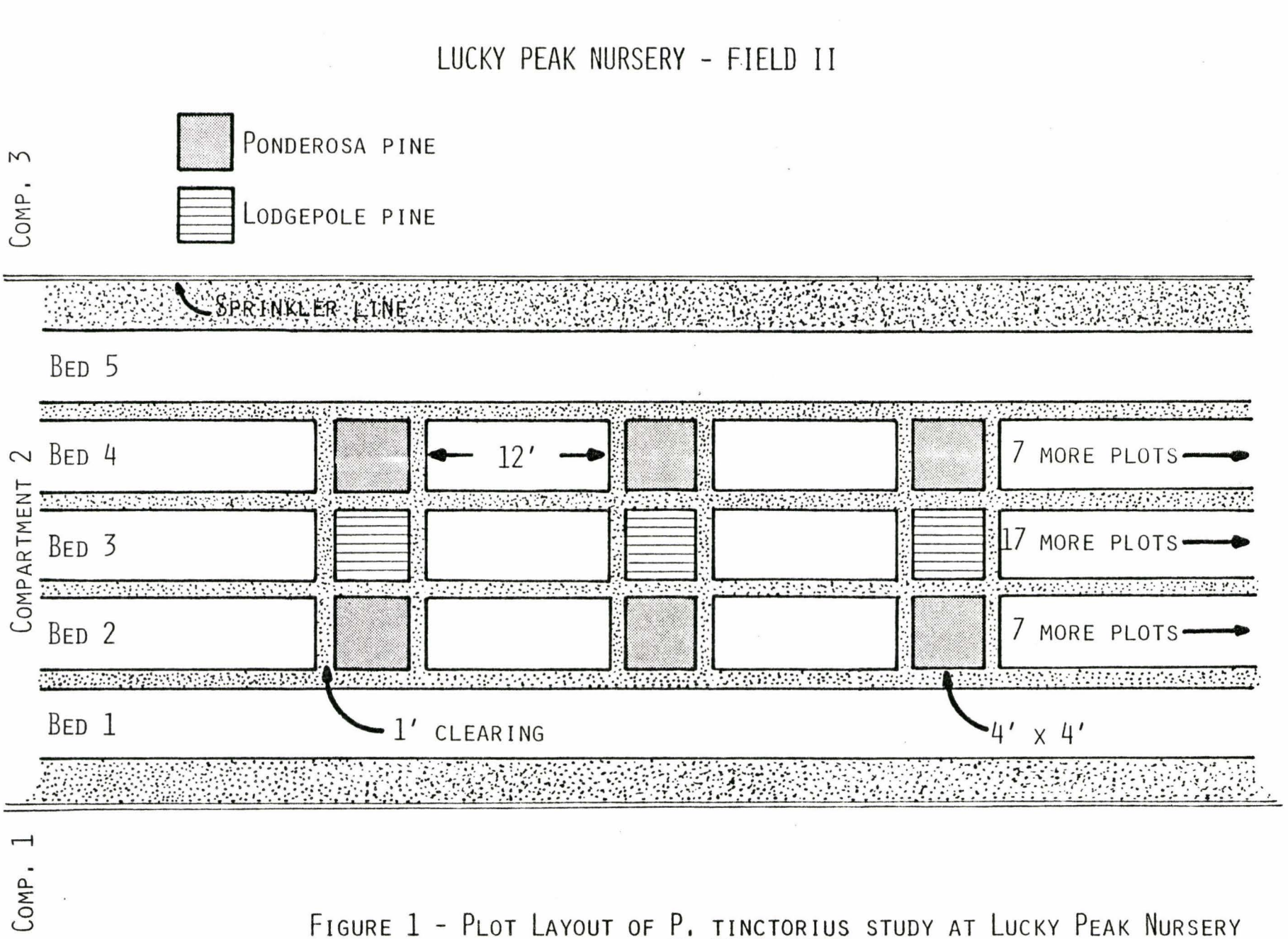

FIGURE 1 - PLOT LAYOUT OF P. TINCTORIUS STUDY AT LUCKY PEAK NURSERY

RESULTS AND DISCUSSION

The seedlings from first-year sampling were received by Abbott Laboratories in excellent shape and examined for the presence of P. tinctorius mycorrhizae. No evidence of P. tinctorius colonization was found (Abbott correspondence with Marshall, December 1981). There was, however, abundant mycorrhizal colonization by what appeared to be Thelephora sp. This is not suprising since Thelephora terristris (Ehrh.) Fr., along with two other mycorrhizal fungi, Suillus sp. and Hebeloma sp., has previously been identified from sporophores collected at Lucky Peak Nursery (personal identifications).

In checking back on the origin of the commercially produced inoculum, Abbott Laboratories noticed the 60-liter lot used in the Lucky Peak study was a portion of a "batch" that had performed poorly in all Abbott tests in 1981. The batch had apparently become badly contaminated with another microbial product under development. The contaminant produces a strong antifungal material. They suspect, but cannot prove, that the contamination is what caused the failures.

Due to the absence of P. tinctorius-formed mycorrhizae, the 1981 study at Lucky Peak Nursery has consequently been terminated.

Based on the following observations, we do not feel that further inoculation studies are warranted.

Although seedbed fumigation (67% methyl bromide--33% chloropicrin @ 350 lbs. per acre) has been a routine practice following cover crop tillage at Lucky Peak, mycorrhizal sporophores are readily observed by the end of the second growing season in beds of ponderosa and lodgepole pine. Assuming these mycorrhizal fungi reinvaded the sterilized seedbeds, likely the fungi were windblown from three possible sources:

1. nearby forested lands;
2. nearby productive seedbeds; and
3. pine growing in the windbreaks at the nursery.

Also, in a recent ectomycorrhizal quantification survey (Marshall, unpublished) of sorted 2-0 pine seedlings, we found 100% (177 of 177) of lodgepole and 99% (99 of 100) of ponderosa seedlings with apparent ectomycorrhizal development. Twenty percent (20 of 100) of the ponderosa seedlings even had Thelephora sporophores adhered to the stems.

Although quantification surveys have not been performed for all beds in the nursery, we presently feel that ectomycorrhizal formation is not deficient on 2-0 ponderosa and lodgepole pine at Lucky Peak Nursery. We therefore do not recommend additional inoculation evaluations at this time.

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